REMARKS

Applicant's Invention

Applicant's invention relates to a process for reducing sulfur from hydrocarbon feedstock. Generally speaking, the inventive process involves what is believed to be a novel application of a membrane separation process to a sulfur reduction technique frequently employed to reduce sulfur in hydrocarbon feedstocks that are processed in petroleum refineries.

Applicant's Background section of his specification provides a detailed description of processes in use to reduce sulfur in hydrocarbon feedstocks. The processes described in the Background are those processes typically used in petroleum refining where there is increasing pressure to remove sulfur and produce cleaner fuels. Applicant's specification describes two basic choices available to the refiner. One choice is the relatively expensive hydrodesulfurization or hydrotreatment processes, which require heavy capital investment. While these processes remove a range of sulfur species typically found in petroleum feedstocks, hydrogen present in these processes results in saturation of the feedstock's olefin content. Such olefins are becoming valuable products to refiners and any loss of olefins is usually to the economic detriment of the process. One particular hydrodesulfurization process available from CD Technologies seeks to reduce the disadvantages of conventional processes. This process is known as the "CD Hydro" process. That process, however, is not optimal in certain situations.

A second choice available to refiners is the use of membranes and membrane modules to remove sulfur from sulfur-containing hydrocarbon streams. While these processes are less expensive to build and operate than conventional hydrotreatment sulfur reduction technologies, there are some inherent limits to the sulfur species that can be removed by such processes.

Applicant has developed a new process incorporating attributes of both types of processes. Applicant believes such a process will provide superior performance that would not be expected from either process alone.

As recited in claim 1, Applicant's invention comprises contacting hydrocarbon feedstock with a Fractionation Zone that produces at least two sulfur containing fractions having differing boiling points. This fractionation is

conducted under catalytic distillation conditions and is not dissimilar to steps taken in prior art process. Unlike the processes mentioned above, Applicant's process does involve subjecting the lower boiling fraction (Fraction 1 recited in claim 1) to a membrane separation process producing a sulfur enriched permeate fraction as compared to the original fraction subjected to the membrane separation. This sulfur enriched fraction from the membrane separation step and the higher boiling fraction from the distillation (Fraction 2 recited in claim 1) are then contacted with a Desulfurization Zone. By first fractioning the sulfur feed into a lighter feed that contains lighter species such as olefins and then only subjecting that feed to membrane separation, a significant portion of the olefins present in the original feed is spared the hydrodesulfurization treatments that remove such species from the product yields in the refinery. At the same time, the process concentrates the heavier feeds that have more of the "difficult to remove sulfur" species not readily removed by the membrane and then allows the conventional processes to reduce those species. It is submitted that the prior art references of record in this application do not suggest or disclose such a process.

Pending Claims

Claims 1-26 were pending in this application. Claim 7 has been cancelled and the subject matter therein has been incorporated into claim 1. Therefore only claims 1-6 and 8-26 are still pending.

May 18, 2006 Office Action

Claims 1, 4-6 and 8-26 are rejected under 35 USC § 103 as being unpatentable over Mihas et al. Briefly it is indicated in the Office Action that Minhas discloses a process of using a membrane to reduce sulfur in sulfur-containing heavy naphtha feed. It is conceded in the Office Action that Minhas does not describe first fractionating the feed. It is alleged in the Office Action, however, that such step would be obvious. The only basis for establishing such a rejection is that Minhas indicates that light naphtha and heavy naphtha comes from a FCC column. This feature is apparently gleaned from the schematic illustration in Minhas' Figure 1.

Claims 2-3 are rejected over Minhas in view of White. It is indicated in the Office Action that while Minhas does not describe using polyureaurethane membranes such as those recited in claims 2-3, White does disclose such

membranes. It is stated in the Office Action that one of ordinary skill would be motivated to modify Minhas' process and utilize polyureaurethane membranes instead of those used by Minhas because of the performance that White noted for the polyureaurethane membranes.

Claim 7 is rejected under § 103 over Minhas further in view of Groten. It is conceded in the Office Action that Minhas does not describe a fractionation process operated under catalytic distillation. Nevertheless, it is stated in the Office Action that Groten does disclose such a process and therefore allegedly motivates one of ordinary skill in the art to modify Minhas' process and utilize a catalytic distillation process. This rejection is made even in light of the concession above that Minhas teaches that the hydrocarbon feed into the Minhas membrane is a from an FCC Distillation column, which is typically a catalyst driven process.

Applicants respectfully request reconsideration of the above rejections in light of the amendment to claim 1.

Minhas

Minhas discloses processes of treating light naphtha feeds. Such feeds can come from what is known as the FCC main column. While Minhas does illustrate a FCC Main Column in Figure 1, it only depicted in schematic fashion and Minhas is completely silent as to the specific conditions employed in the column. That said, it is respectfully submitted that one would view Minhas' disclosure through the eyes of the ordinary artisan, and it is submitted that one of ordinary skill would know that typical FCC columns are typically operated under simple (non-catalytic) distillation conditions.

Claim 1 now recites that the fractionation process to be carried out prior to the membrane separation process of Applicant's invention is under catalytic distillation conditions. Minhas provides no motivation at all to employ such fractionation processes. Operating a catalytic distillation step has different considerations than simple distillation processes and therefore one of ordinary skill would not necessarily be drawn to use catalytic processes in place of simple distillation processes. For example, Groten (discussed below) describes on column 3, lines 26-30, the specific conditions involved with catalytic distillation. Briefly catalytic distillation involves catalytically and chemically reacting the feed to the unit. Feed and products of the reaction are then distilled from the unit.

Simple distillation however does not require such conditions and is basically driven by the boiling points of the fractions being separated. Therefore Applicant requests withdrawal of the rejection of claims 1, 4-6 and 8-26 in light of Minhas alone.

White

White goes no further in suggesting Applicant's invention as now recited in claim 1. White does not describe subjecting the feed to catalytic distillation prior to introducing feed into the membrane module, and therefore even if one of ordinary skill in the art were to substitute Minhas' membranes with the polyureaurethane membranes of White, one would not arrive at Applicant's invention.

The Figure in White moreover discloses employing a membrane prior to utilizing conventional sulfur reduction processes. Since the kind of catalytic distillation contemplated by Applicant is utilized as part of an overall sulfur reduction technology available from CD Tech, it is submitted that one of ordinary skill would be motivated by White to run a membrane process prior to sending the stream to a catalytic distillation process, not the other way around. Indeed, White mentions CD Tech processes in column 6, lines 38-48 as an example of a suitable sulfur reduction technology that can be run on the sulfur rich permeates from the membrane. Applicant therefore requests withdrawal of the rejection of claims 2-3 over Minhas further in view of White.

Groten

Groten describes a variation to a general process utilizing a combination of a catalytic distillation and subsequent hydrotreating step. These process steps are disclosed and illustrated by Groten to be in series. See items 16 and 22 in Groten's only Figure. That said, one in hindsight can compare these two steps as similar to steps (a) and (d), respectively, as recited in Claim 1.

Groten however discloses using the two aforementioned steps in series and does not disclose or suggest utilizing a membrane on a stream leaving the distillation step and prior to being treated in the hydrotreatment step. Moreover, Groten discloses utilizing the overall process to treat a naphtha stream. When one looks at Figure 1 in Minhas it is submitted that one of one of ordinary skill would consider utilizing such a two step process as the "Hydrotreatment" process

schematically illustrated at the bottom of the Figure, or perhaps even try the process as a replacement for the membrane module illustrated at the top of the figure. Neither suggestion however results in Applicant's invention. The Examiner has not pointed to any suggestion by Groten to break up the seriatim treatment of hydrocarbon with a significant membrane separation process such as that employed in Applicant's invention, or to somehow only employ one of part of Groten's overall process in place of the FCC main column disclosed by Minhas. Applicant therefore requests withdrawal of the rejection of claim 7 over Minhas further in view of Groten.

Respectfully submitted,

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